Technical Documentation to Support Development of Minimum Flows and Levels for the Caloosahatchee River and Estuary

Appendix A

Caloosahatchee River MFL Research Program Progress Report

Contents

Florida Bay and Lower West Coast Division
Southern District Restoration Department

South Florida Water Management District

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Caloosahatchee River MFL Research Program -- Progress Report

Introduction

As part of the development of the Caloosahatchee MFL, a scientific peer review of the technical criteria was conducted and a report produced (Edwards et al 2000). Comments from the public and other State and Federal agencies also were solicited. The review committee approved the general scientific approach used in establishing the MFL.   However, specific scientific deficiencies in the technical documentation of the rule were identified.   A research program was initiated to address these concerns and included additional field observations, laboratory experiments and development of modeling tools. Major criticisms of the initial effort were:

1. Lack of a hydrodynamic/salinity model
2. Lack of a population model for *Vallisneria americana*
3. No quantification of the habitat value of *V. americana* beds
4. Effects of MFL flows on downstream estuarine biota

Research Program Components:

Component 1: CH3D Hydrodynamic salinity model of Caloosahatchee:

Background: A CH3D hydrodynamic model originally developed for the entire Charlotte Harbor system is being adapted for use in the Caloosahatchee. The model is three dimensional, time-dependant and employs a curvilinear grid. The purpose of the modeling effort is two-fold. The first is to simulate the distribution of salinity in the estuary under minimum flow conditions. The present MFL rule states that a discharge of 300 cfs at S-79 is necessary to maintain a salinity of 10 ppt at the Ft. Myers Yacht Basin. The model will be used to evaluate this proposition.

The second use of the model will be to reconstruct the 31-year salinity history in the protected area under different land use conditions in the watershed. Specifically, conditions with and without CERP projects will be contrasted. The CERP Projects are the recovery strategy for the MFL and this exercise will evaluate this strategy.

Status: The model has been calibrated using a 3-month data set, without ground water input. Validation using an additional 3 months is underway. Flow vs salinity distribution curves for constant discharges have been developed. A multiple regression model that relates daily salinity at Ft. Myers and at Bridge 31 to discharge at S-79 has been developed and calibrated using a 10 year period of daily salinity data. It is now possible to predict daily average salinity for 31 years at Ft. Myers, Rte. 31 Bridge and through interpolation, two stations located between Ft. Myers and Bridge 31.

Future Improvements: The District is working to improve the CH3D model. The model has inadequate bathymetry and a survey of the Caloosahatchee is planned for FY03. Further calibration and validation are required with groundwater and tributary input from the tidal basin. The speed of the model will be improved by acquisition of a new parallel code and grid editor.

Component 2: Population model for *Vallisneria americana*

Background: A Stella based population level model of *V. americana* in the Caloosahatchee is currently under development. The purpose is to include more environmental factors than just salinity and arrive at a better estimate of the effects of freshwater inflow on performance of *V. americana*. In conjunction with 31 years of salinity data, the model will be used to evaluate present and future ability to meet MFL. The model will not be totally complete in time for the criteria review. Nevertheless, we will attempt to use the model as it is.

Status: The original model had one forcing function: salinity. The new model has salinity, light, and temperature. The model has been calibrated using four years of data (1998-2001). At present, the model can simulate growth of *V. americana* at two stations in the protected area of the estuary.

Future Improvements: Additional input data and information concerning the growth and survival of *V. americana* in the Caloosahatchee Estuary will be required to make the model more robust. Specific needs are to:

1. Develop a method to predict variation in water transparency for long-term or other simulations.

2. Develop relationships to relate mass to blade and shoot densities, and blade length with existing data.

3. Develop improved algorithms for light and salinity.

4. Incorporate blade length as a state variable to more accurately represent light availability for mature plants.

5. Add population and demographic characteristics to describe seed production and dispersal.

Component 3: Additional Experimental Studies

Background: Two experiments at the Gumbo Limbo Mesocosm Facility will provide addition data for the *V. americana* modeling effort.   An experiment quantifying the response of *V. americana* to high salinity has already been conducted.   We now have data on growth and mortality of *V. americana* at salinities ranging from 0 to 30 ppt.   An experiment evaluating the interaction of light and salinity was conducted in April and May, 2002.

Status: Both experiments have been conducted. Results of the first have been incorporated into the model. Results of the second will not be available for this review.

Component 4: Quantify the habitat value of *Vallisneria americana* beds

Background: This is being accomplished through a contract (C-12836) with Mote Marine Lab (3 years). The overall objective is to identify which organisms use *V. americana* habitat in the Caloosahatchee River and how season, salinity and plant /bed morphometry affect habitat use.

Status: The study began in January of 2002. Results will not be available for this review.

Component 5: Effects of MFL flows on other biota, especially those located downstream

Flow Effects on Oysters

Background: Effects of low flows on downstream oysters, *Crassostrea virginica*, are being examined through a contract (C-12412) with Florida Gulf Coast University. The objectives of this study are several fold:

1. To examine seasonally the mortality and disease prevalence.

2. To investigate growth, mortality and reproductive potential of oysters under various salinity regimes.

3. To study oyster spat settlement as a function of salinity.

4. To investigate the role of oyster reefs as essential fish habitat and determine whether the condition of individual oysters affects overall habitat suitability.

Status: Dr. Volety, Principal Investigator, has submitted a progress report (July 2002) that addresses the freshwater inflow requirements of oysters in the Caloosahatchee.

Effects of Flows on Zooplankton and Ichthyoplankton

Background: The District has monitored zooplankton and larval planktonic fish at 7 stations in the Caloosahatchee Estuary, San Carlos Bay under a range of freshwater discharge conditions at S-79. Monitoring was not continuous but occurred on a monthly basis during the following periods 1986 – 1989, 1994-1995, and 1998. Data have been analyzed to investigate the effects of discharge on the abundance and distribution of these groups in the estuary.

Component 6: Monitoring of *Vallisneria americana* beds.

Background: A monthly monitoring program at four stations was initiated in 1998. The data are used to examine potential effects of salinity and other water quality parameters on Vallisneria.

Status: On-going

Component 7. *Vallisneria americana* Restoration and Seed Bank Studies

Background: These studies are being carried out through contract with the Conservancy of Southwest Florida and are intended to:

1. Determine the importance of the seed bank in reestablishing tape grass

2. Determine if planting seagrasses enhances their reestablishment

3. Establish the optimal conditions and methods for tape grass re-vegetation

4. Calculate an effort (time, expenditure) budget for a tape grass restoration program

Status: Started August 2003. On-going

Literature Cited

Edwards, R. E., W. Lung, P.A. Montagna, and H. L. Windom. 2000. Final review report. Caloosahatchee Minimum Flow Peer Review Panel, September 27-29, 2000. Report to the South Florida Water Management District, West Palm Beach, FL.